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Art. I.—MAURY'S SAILING DIRECTIONS.*

We have in this book, with its unpretending and uninviting title, another instance of the great results that spring from small facts and simple ideas. We will not venture to compare the results before us with those that sprang from Newton's apple or Galvani's frog, for from one we have the great law of gravitation, and from the other the magnetic telegraph; but we will venture to assert that since the invention of the mariner's compass, and its great adjunct, the chronometer, no such boon has been given to Commerce, and through it to civilization, as this book confers.

The small and apparently unimportant fact that when a commander was appointed, for the first time, to a ship bound from a port in the United States to Rio de Janeiro, he naturally enough asked some other captain, familiar with the route, to point out the best course to steer in order to make the quickest passage, turned over in the philosophic and comprehensive mind of the author, gave birth to the simple idea of collecting and setting forth the experience and knowledge of all.

With the hearty co-operation and support of Commodores Crane, Warrington, and Morris, successive Chiefs of the Bureau of Ordnance and Hydrography, and backed by the authority of the Navy Department under Mason, Preston, Graham, Kennedy, and Dobbin, Mr. Maury set himself earnestly to work in the collection of his facts.

Circulars were issued, addressed to the commanders of merchant vessels trading on every sea, inviting their co-operation in the work; but these were slow to take the idea. They required facts and proof, not reasoning; and

* Explanations and Sailing Directions to accompany the Wind and Current Charts, approved by Com. Charles Morris, Chief of Bureau of Ordnance and Hydrography; and published by authority of Hon. J. C. Dobbin, Secretary of the Navy. By M. F. Maury, LL. D., Lieut. of U. S. Navy, Superintendent of National Observatory. Sixth Edition, enlarged and improved. Philadelphia: E. C. & J. Biddle. 1854.

it was accordingly determined to start with what could be gathered from log-books of the navy, preserved in the Bureau of Hydrography. No great number of these could be found, nor were they very valuable, because they had not been kept with reference to this work; yet enough was gathered to induce Mr. Maury to express the opinion that there was a shorter and better route to Rio than the one usually pursued. The bark W. H. D. C. Wright, of Baltimore, Jackson, commander, was the first to try this new route. She crossed the line in longitude 31 degrees west on the twenty-fourth day out, (the usual time before was forty-one days,) and made the trip to Rio and back in seventy-five days. We have known a vessel over one hundred days in going out alone.

This was enough: it was the proof the merchant captain required. One by one, they gave in adhesion to the plan.

Ship after ship joined the corps of observers, so that more than a thousand navigators are now busied night and day, in all parts of the world, in making observations, and gratuitously collecting materials of great value to science, Commerce, and navigation. Never before has there been such a corps of observers scattered over the world, yet laboring together, and acting in concert with regard to any system or subject of philosophic research. Pages 107, 108.

Let us now see what results have been already obtained from the observations of this corps in the hands of Lieut. Maury.

The average passage to the equator of vessels bound from ports in the United States to Rio de Janeiro, before the revelations of the Wind and Current Charts, was forty-one days; the average now is a fraction short of thirty days. The "Sea Serpent" went it in eighteen days in the month of March; and the captain of the "Stag Hound" believes he would have made it in sixteen, but for the loss of his main topmast, which deprived him of the main topsail for nine, and of all the topgallant sails for twelve days. It is to be understood that all difficulties in the passage to Rio are, as a general rule, surmounted when the "line" is crossed.

The author thus modestly and gracefully alludes to the great benefit here conferred upon Commerce:—

A saving of 25 per cent in time for all the men and the Commerce that pass that way, is certainly an achievement which those who have co-operated and worked together to bring about may well contemplate with pleasure and satisfaction. And who are they? Sailor-men all!—the navigator who has assisted in the collection of materials, and the brother officer who has so faithfully and patiently helped to discuss them here. Page 545.

It is not to be supposed that Mr. Maury did not meet with both opposition and difficulty in the prosecution of his enterprise. There is no class of people more opinionated, or who more dislike innovation, than old sailors; and it is not until within the last few years that most of them have risen superior to their prejudices. Consequently there was discontent and opposition, and we have heard many a hearty anathema on these "d—d new-fangled notions."

The difficulties he encountered, though vexatious enough, were sometimes ludicrous. One captain, soon after its announcement, tried the new route. About the time he crossed the equator he thought he would get an observation for latitude; he did so, but in the calculation he committed the error of taking the sum instead of the difference of the sun's declination and its zenith distance, which placed his vessel in about the latitude of Rio. He accordingly steered off to the westward, and made the land about the mouth

of the Amazon. He thought it all right, and steered on until he got into five fathoms water; this, he knew, was not the depth of water about the port of Rio, so he became mystified, and stood off and on the land for several days, until the mate, happening to ascend the rigging a short distance, discovered the North Star in the horizon. This opened the captain's eyes, and he stood off to the northeast to make up his longitude so as to weather Cape St. Roque. He encountered light winds and westerly currents, and after a lapse of sixty-seven days he regained, within ten miles, the same place on the line that he had left when he put his helm up to run off to the westward. He had 118 days to Rio. This seems incredible, but "we tell the tale as 'twas told to us;" and we can account in no other way for the fact that the captain, with a fair wind for his port, should steer away from it.

The average passage out to California of vessels not having the results of these researches to guide them is upwards of 180 days; but vessels with these charts on board have made it in 107, in 97, in 96, in 91, and even in 90 days; and their masters, after making allowance for the improved model of their ships, ascribe this great success to the information which they derived from these charts as to the winds and currents by the way. P. 14.

This work of induction, reasoning, and pure science has, in this connection, the absorbing interest of romance, and we know scarcely any thing more exciting and interesting than a race of four fine clipper ships from New York to California. The ships are tracked through almost every day and degree of their long course; and the calms that baffled one, the storms that beat back another, the mistakes and accidents that delayed a third and a fourth, are noted and commented upon in a style and language that add much to the pleasure and excitement of the race. We cannot refrain from quoting a specimen:—

All sailed from New York in the autumn of 1852. The Wild Pigeon, October 12th, the John Gilpin, October 29th, the Flying Fish, November 1st, and the Trade Wind, November 14th. It was the season for the best passages. Each one was provided with the Wind and Current Charts. Each one had evidently studied them attentively; and each one was resolved to make the most of them and do his best. All ran against time; but the John Gilpin and the Flying Fish for the whole course, and the Wild Pigeon for part of it, ran neck and neck, the one against the other, and each against all. It was a sweepstakes with these ships, around Cape Horn and through both hemispheres. * *

Evidently the Fish was most confident that she had the heels of her competitors—she felt her strength and rejoiced in it; she was most anxious for a quick run, and eager withal for a trial. She dashed down southwardly from Sandy Hook, looking occasionally at the charts; but feeling proud in her sweep of wing, and trusting confidently in the judgment of her master, she kept, on the average, 200 miles to leeward of the right track. Rejoicing in her many noble and fine qualities, she crowded on her canvas to its utmost stretch, trusting quite as much to her heels as to the charts, and performed the extraordinary feat of crossing, the sixteenth day out from New York, the parallel of 5 degrees north.

The next day she was well south of 4 degrees north, and in the doldrums, longitude 34 degrees west.

Now her heels became paralyzed, her fortune seems to have deserted her awhile—at least her master, as the winds failed him, feared so; they gave him his motive power—they were fickle, and he was helplessly baffled by them. The bugbear of a northwest current off Cape St. Roque began to loom up in his imagination, and to look alarming; then the dread of falling to leeward came upon him. Chances and luck seemed to conspire against him, and the mere possibility of finding his ship backstrapped filled the mind of Nickels with evil forebodings, and

shook his faith in his guide. He doubted the charts, and committed *the* mistake of the passage.

The Sailing Directions had cautioned the navigator again and again not to attempt to fan along to the eastward in the equatorial doldrums; for by so doing he would himself engage in a fruitless strife with baffling airs, sometimes reinforced in their weakness by westerly currents. But the winds had failed; and so, too, the smart captain of the Flying Fish evidently thought had the Sailing Directions.

The Sailing Directions advise the navigator to cross the calm belt in as straight a line as the winds will allow, not fearing the land about Cape St. Roque, or the current that is supposed to sweep round it.

Nickels, forgetting that the charts are founded on the experience of great numbers, being tempted, turned a deaf ear to the caution, and flung away three whole days and more of most precious time dallying in the doldrums.

He spent two days about the parallel of 3 degrees north, and his ship left the doldrums, after this waste of time, nearly upon the same meridian at which she entered them.

She was still in 34 degrees, the current keeping her back just as fast as she could fan east. After so great a loss, her very clever master became sensible of his error. Leaving the spell-bound calms behind him where he had undergone such great trials, he wrote in his log as follows: "I now regret that, after making so fine a run to 5 degrees north, I did not dash on and work my way to windward to the northward of St. Roque, as I have experienced little or no westerly set since passing the equator, whilst three or four days have been lost in working to the eastward between the parallels of 5 and 3 degrees north against a strong westerly set"—and, he might have added, with little or no wind.

In three days after this he was clear of St. Roque. Just five days before him, the Hazard had passed exactly in the same place, and gained two days on the Fish by cutting straight across the doldrums, as the Sailing Directions advised him to do.

The Wild Pigeon arrived first off Cape Horn; but here she met with a westerly gale which detained her ten days, while her competitors, the Fish and the Gilpin, were coming up fast with fine winds and flowing sheets. The three swung round the Horn together, as if entering on the *quarter stretch.*

On the 30th of December, the three ships crossed the parallel of 35 degrees south, (in the Pacific,) the first recognizing the Pigeon; the Pigeon saw only "a clipper ship"—for she could not conceive how the ship in sight could possibly be the Flying Fish, as that vessel was not to leave New York for some three weeks after she did. The Gilpin was only 30 or 40 miles off at the same time.

The race was now wing and wing, and had become exciting. With fair winds and an open sea, the competitors had now a clear stretch to the equator of 2,500 miles before them.

The Flying Fish led the way, the Wild Pigeon pressing her hard, and both dropping the Gilpin quite rapidly, who was edging off to the westward.

The two foremost reached the equator on the 13th of January, the Fish leading just 25 miles in latitude, and crossing in 112 deg. 17 min., the Pigeon 40 miles further to the east.

The Gilpin crossed the equator two days afterwards in 116 degrees, and made the glorious run of 15 days thence to the Pilot Grounds off San Francisco.

The Flying Fish beat. She made the passage in 92 days and 4 hours from port to anchor. The Gilpin in 93 days and 20 hours from port to pilot. The Wild Pigeon had 118. The Trade Wind followed with 102 days, having taken fire and burned for eight hours on the way.

The result of this race may be taken as an illustration as to how well navigators are now brought to understand the winds and currents of the sea.

Here are three ships, sailing on different days, bound over a trackless waste of ocean for some 15,000 miles or more, and depending alone on the fickle winds of heaven, as they are called, to waft them along; yet, like travelers on the land bound upon the same journey, they pass and repass, fall in with and recognize each other by the way; and what perhaps is still more remarkable is the fact that these ships should each, throughout that great distance, and under the wonderful vicissitudes of climates, winds, and currents which they encountered, have been so skillfully navigated that, in looking back on their management, now that what is passed is before me, I do not find a single occasion on which they could have been better handled, except in the single instance of the Flying Fish while crossing the doldrums in the Atlantic. And this mistake her own master was prompt to discover and quick to correct. Pages 724, 730.

The average saving of time effected by the Wind and Current Charts and Sailing Directions in the voyage between New York and California is 35 days. When Mr. Maury was in England, he told the merchants there that if they would join with him in these investigations, he would undertake to shorten the outward passage from England to Australia between 20 and 30 days, and the homeward from 15 to 20. An American ship was then loading in Liverpool for Australia, and was furnished by Mr. Maury with complete directions. We now have the result: she made the passage in 78 days. The average before was 111; so that we have a shortening of 33 days. We shall refer again to this Australian route.

One of the most remarkable things attending the investigations into the winds and currents, is the almost marvelous verification of theory by results. By close examination of the information collected, Mr. Maury was enabled in a letter to Captain McKay, of the Sovereign of the Seas, on one of his voyages to California, to express the opinion that he, by following out the directions given, would cross the equator in the Pacific at such a time, and would arrive at San Francisco at such another. Both of these conjectures were verified to the day. We can only look upon this as a casualty; but it made a wonderful impression on the minds of maritime people at the time, and strengthened Mr. Maury's hands for good. There are other instances of this same thing.

In calculating the best routes for the different months, I have also calculated the distance which a vessel, undertaking to follow these routes, would have to accomplish on account of detour caused by head winds, &c. On this occasion, (the race of the clipper ships above described,) only the John Gilpin and the Hazard entered the distance by log from New York to the line. The distance which, according to the Sailing Directions, each vessel would at that season of the year—after allowing for the deviations which head winds would require her to make from the straight course—have to sail to reach the equator, is 4,115 miles. The Gilpin actually logged 4,099, the Hazard 4,077; thus accomplishing, in the year 1852, the voyage by sailing the one within 38, the other within 16 miles, the distance which by calculation in 1849 it was predicted they would have to accomplish. Instances of the like are now of common occurrence. P. 730.

There is something of the same kind in the European routes. These routes are calculated from the "Pilot Chart," and they represent, each for its month, the best track on the *average* which a vessel can make.

Take the route from New York in March for illustration. It will be seen by the table that the course recommended from longitude 55 to 50 degrees is east, and that the winds are from east, on the average, 1.9 per cent of the time; and that a vessel, in steering east there, would be headed off from her course by slant winds from the northward 2.8 times, and by slant winds from the southward 15.9 times in the hundred; and that these proportions are derived from the rec-

ords of 108 vessels between these meridians in that month, or, which is the same, by 108 observations there during the month of March of different years.

The south, therefore, is the windward side then and there. Therefore these facts, thus presented, will leave the navigator, when he comes to be headed off from his course in that part of the route, in no doubt as to which tack to go upon. With the wind directly ahead, or east, he should stand to the southward or to windward, because the probabilities of the wind coming out from that quarter are greater than they are that it will come from the north.

Again, from the meridian of thirty-five degrees to thirty degrees west, the best average course is E. N. E. 1.3 per cent of the winds are dead ahead, and 19 are slant from the northward against 4.3 from the other side. Here, then, it is shown from the records of eighty vessels, that the northward is the windward side.

I have the record of two vessels which were together in this part of the ocean on their way to Europe. They had kept together so far on their way; they sailed alike; when they arrived here, the wind came out ahead—one went off on the larboard tack, (to the southward,) the other on the starboard tack, (to the northward;) the latter arrived in port ten days before the other. P. 394.

One instance more. Mr. Maury was requested to furnish instructions for two government vessels detailed to search for the ill-fated San Francisco. He directed one of these that sailed from the port of New London to steer for the intersection of the parallel of 40 degrees N. with the meridian of 70 degrees W., and then run outward along the parallel. Had this vessel been in time, she would have fallen in with the steamer, for this sunk within sight of the intersection of the parallel of 40 degrees with the meridian of 60 degrees. The searching vessel was instructed to strike the parallel of 40 degrees so far to the westward that she might be inside of the San Francisco, and speak all vessels bound in, that would cross the Gulf Stream between the parallels of 35 degrees and 45 degrees, and the meridians of 55 degrees and 65 degrees.

Here seem to us wonderful confirmation of the truth and value of the doctrine of chances. It is the same on which are based calculations of the longevity of classes or occupations; and on which policies of insurance, whether for life or property, are issued.

We have related a few *facts* tending to show the utility of the work under discussion; now let us look to *opinion* on this subject. In a letter of a committee of the Royal Society of London to Mr. Addington, occur the following paragraphs:—

With reference to the suggestions made by the scientific men of the United States, the proposition of Lieut. Maury to give a greater extension and more systematic direction to the meteorological observations to be made at sea, appears to be deserving of the most serious attention of the Board of Admiralty.

Short as is the time that this system, (Maury's Investigations into the Winds and Currents,) has been in operation, the results to which it has led have proved of very great importance to the interests of navigation and Commerce. The routes to many of the most frequented ports in different parts of the globe have been materially shortened—that to San Francisco, in California, by nearly one-third; a system of southerly monsoons in the equatorial regions of the Atlantic and on the west coast of America has been discovered; a vibratory motion of the trade-wind zones, with their belts of calms, and their limits for every month of the year, has been determined; the course, bifurcation, limits, and other phenomena of the great Gulf Stream have been more accurately defined; and the existence of almost equally remarkable systems of currents in the Indian Ocean, on the coast of China, on the northwestern coast of America, and elsewhere, has been ascertained. There are, in fact, very few departments of the science

of meteorology and hydrography which have not received very valuable additions; whilst the most accurate determination of the parts of the Pacific Ocean —which are very limited in extent—where the sperm whale is found, as well as the limits of the range of those of other species, has contributed very materially to the success of the American whale fishery, one of the most extensive and productive of all the fields of enterprise and industry. P. 35

M. Jomard, a distinguished French savan, says, in a letter to Robert Walsh, U. S. Consul at Paris:—

You can tell him (Lieut. Maury) that no one appreciates more than I do the merits of his Charts of Winds and Currents, and the immense service he renders to navigation and the Commerce of all people. What do I say?—to humanity and to civilization.

Humboldt says, writing to Dr. Flügel, U. S. Consul at Leipzig:—

I beg you to express to Lieut. Maury, the author of the beautiful Charts of the Winds and Currents, prepared with so much care and profound learning, my hearty gratitude and esteem. It is a great undertaking, equally important to the practical navigator and for the advance of meteorology in general. The shortening of the voyage from the United States to the equator is a beautiful result of this undertaking. Pages 3 and 4.

The testimonials of the merchant captains to the value of these Wind and Current Charts are very numerous. We will quote only a few. Capt. Frank Smith, of the Messenger, says:—

I deem it but proper to say ere I close that I feel myself, (in common with the great maritime interests of our country,) greatly indebted to your invaluable researches, and the great skill you have developed in laying such a mass of information before us in such an available form as we have in your charts; and I trust your flattering success continues to animate you, and that you will make us, in due time, as familiar with the great Pacific and Indian oceans as you have with the Atlantic. That old and beaten track has been brought out of darkness into marvelous light; and I expect many important errors have possession of our minds with regard to the others which your researches are destined to dispel. And your beautiful theory on the circulation of the atmosphere gives a charm to its study that cannot fail to excite such an interest on the subject as will make every thinking sailor more attentive and observant of the great laws of nature in action around him. P. 696.

Capt. Stickney, of the ship Corinne, says:—

Your sailing directions, with the accompanying charts, contain much valuable information, and I would recommend them to every ship-master, in whatever trade he may be, with regard to doubling Cape Horn. P. 649.

Capt. Hallett, of ship Phantom:—

Now shall make a straight course for 115 longitude in parallel of 37 degrees north, as per your valuable sailing directions, which I think much of. P. 590.

Capt. Homans, Winged Racer:—

I take this opportunity to acknowledge the great benefit I have derived from your charts and directions, and shall most readily contribute what little I can to aid you in the great and good undertaking. P. 584.

Capt. Phinney, of the Kentucky:—

In conclusion, I cannot refrain from expressing my sense of the benefit I feel that your labors have already conferred upon the commercial world, and also my

hope that you may be permitted to follow up these researches and investigations, by which I believe navigation will, in a few years, become quite a different matter from what it has been in times past. P. 577.

Capt. Lovell, Wings of the Morning :—

Your very, very valuable Sailing Directions and Charts I consider the best guide ever given to the navigator for pointing out the way to shorten the passage between New York and Rio. P. 453.

Capt. Hartshorn, of the "E. Z.," informs me that on his last voyage in 1852 from Liverpool to New York, he made these charts his guide ; that he made the most remarkable passage of the season, (19 days,) and that vessels which sailed about the same time he did, did not arrive for 20 days and more after he did. He attributes his success to the lights which the experience of others, expressed by these charts, afforded him. P. 394.

Eldridge, of the Roscius, Clark, of the Wright, Myrick, of the Diadem, with many others, add their testimony to the value of the directions and the charts; and a large number of the merchants of New York evinced their appreciation of the services rendered to Commerce by this work, by presenting the author with a service of plate and the sum of five thousand dollars.

But a better exponent of the value of the author's labors than opinion, even though it be that of great scientific men and practical men, is to be found in the action of governments. At his suggestion, most of the maritime nations of Europe sent representatives to meet Mr. Maury in conference as to the best mode of extending these valuable researches and making them general.

Representatives from Belgium, Denmark, France, Great Britain, Netherlands, Norway, Portugal, Russia, Sweden, and the United States, met at Brussels to confer on the subject of establishing a uniform system of meteorological observations at sea, and of concurring in a general plan of observations on the winds and currents of the ocean.

This was a remarkable meeting. The persons composing it were nearly all military men, representatives of nations that had often stood opposed in deadly hostility; yet they were now here in friendly conference devising ways and means of facilitating intercourse; of extending commercial relations by practically shortening the distance that divides these nations; and of binding the red hands of rivalry and war in the strong chains of a common interest. Truly, it seems to us, that if the world owes nothing else to Mr. Maury, it owes him a debt of gratitude for the suggestion of the Brussels Conference.

It cannot be denied that our distinguished countryman occupied the most prominent place in this conference. He stated the object of the meeting, he drew up the report, and received the thanks of the members three several times by unanimous vote. We quote the concluding paragraph but one of the report to show the enlightened spirit that animated the members of the conference :—

Lastly, the conference feels that it would but inadequately discharge its duties did it close this report without endeavoring to procure for these observations a consideration which would secure them from damage or loss in time of war, and invites that inviolate protection which science claims at the hands of every enlightened nation; and that as vessels on discovery or scientific research are, by consent, suffered to pass unmolested in time of war, we may claim for these documents a like exception, and hope that observers amidst the excitement of

war, and perhaps enemies in other respects, may in this continue their friendly assistance, and pursue their occupation, until at length every part of the ocean shall be brought within the domain of philosophical research, and a system of investigation shall be spread as a net over its surface, and it become rich in its benefit to Commerce, navigation, and science, and productive of good to mankind. P. 60.

We believe that the example of this inviolability of scientific research was first set by the unfortunate but magnanimous Louis XVI., who, when applied to for exemption from capture of Cook's vessel, replied that he warred not on science.

The conference conducted and finished its labors in harmony and unanimity. If so much has been done for the interests of Commerce and navigation by a single institution, (the Hydrographic Office at Washington,) what may we not expect, now that we have the great maritime nations of Europe with their gigantic fleets pledged to engage in the same work, and by general and common modes?

This work will also extend farther. Spain, Sardinia, Brazil, and all the South American republics, have expressed their wishes to join in the universal system; and we have no doubt, although the Royal Society expressed the opinion that it was inexpedient to propose a general and common system of meteorological observations on land, that it will, nevertheless, eventually extend to the land; for Maury found Quetelet, of Belgium, Kupper, of Russia, Jomard, of France, Ballot, of Holland, the governments of Portugal and Spain, and the Meteorological Society of Great Britain, in favor of his first proposition, which was to include both sea and land. Nature then, under this system of close and general investigation, will be compelled to give up many of her secrets, which, from what we have already gained, may well be supposed to be fraught with incalculable benefit to the human race.

It is not, however, to the interests of Commerce alone that this great work is directed. Besides that the mariner is given minute directions by which he may guide his vessel with more certainty and speed over the trackless waste, thus saving and enhancing the value of his owner's property, the husbandman may find in it much of practical value, and the philosopher a *pabulum animi*, upon which he may feed with delight and fatten on its richness. The author says, pp. 4 and 5:—

A wider field or one more rich with promise has never engaged the attention of the philosopher. Though much trodden and often frequented, it has never been explored, if we take exploration to mean the collecting and grouping all those phenomena which mariners observe in relation to the ocean, and the air above it, with the view of tracing, in the true spirit of inductive philosophy, fact into effect, and effect up to cause.

The wind and rain; the vapor and the cloud; the tide, the current, the saltness, and depth, and temperature, and color of the sea; the shade of the sky; the temperature of the air; the tint and shape of the clouds; the hight of the trees on the shore; the size of the leaves; the brilliancy of the flowers,—each and all may be regarded as the exponent of certain philosophical combinations, and therefore as the expressions in which nature choses to announce her own meaning; or, if we please, as the language in which she writes down the operation of her own laws. To understand that language and to interpret aright those laws, is the object of the undertaking which those who co-operate with me have in hand. No fact gathered in such a field as this, therefore, can come amiss to those who tread the walks of inductive philosophy; for in the hand-book of nature every such fact is a syllable; and it is by patiently collecting fact after fact, and joining together syllable after syllable, that we may finally seek to read

aright from the great volume which the mariner at sea and the philosopher on the mountain sees spread out before him.

The author then goes on, in a series of elegant and most instructive papers, to illustrate and teach by example how much may be done by this "patient gathering of fact after fact, and joining together syllable after syllable."

The first of these papers is on the influence of the Gulf Stream on the trade of Charleston; then follow the Currents of the Sea; the General Circulation of the Atmosphere: Red Fogs and Sea Dust; Magnetism and the Circulation of the Atmosphere; Of Clouds and the Equatorial Cloud-ring; On the Geological Agency of the Winds; On the Saltness of the Sea; and the Open Sea in the Arctic Ocean.

These papers are all exceedingly philosophical and beautiful—written in a most attractive style, and occasionally setting forth very strange and important things—such, for instance, as the proof from induction, that the Gulf Stream is a current of water running up hill; that the currents which enter the Mediterranean and Red Sea run down hill, and that there is a counter current of salter and heavier water running out into the Atlantic and Indian oceans below these entering currents; that there is a system of southerly monsoons in the equatorial regions of the Atlantic, of another in the Gulf of Mexico, and off the west coast of America in the Pacific; that the trade-wind zones, with their belts of calms, have a vibratory motion on the meridian, the limits of which are determined and pointed out for each month; that the S. E. trade-winds are stronger than the N. E., and cover a broader belt on the ocean; that the prevailing winds of the Southern are stronger than those of the Northern hemisphere; that the mean temperature of the Northern is higher than that of the Southern hemisphere. The causes of the rainy and dry seasons are set forth, and also the means of telling wherever on the earth's surface the seasons are so divided by nature; the parts of the ocean in which sperm and right whales most resort is discovered and pointed out; also the interesting fact in the natural history of this animal, that the right whale cannot cross the Torrid Zone, &c.

Besides these, which are susceptible of proof, these papers give reason to believe that the air which the S. E. trade-winds discharge into the belt of equatorial calms, after ascending there, flows, for the most part, over into the Northern hemisphere; while that which the N. E. trades discharge into the same belt, passes in like manner over into the Southern hemisphere. Indeed, this may be said to be susceptible of proof; for we learn from the paper on the "Red fogs and sea dust" that these phenomena have been, in the author's mind, converted into tallies for the atmosphere. The miscroscope of Professor Ehrunburg has discovered that these are not fogs or dust, but infusoria and organisms, whose "habitat" is in the S. E. trade-wind region of South America. Their place of deposit is about the region of the Cape de Verd Islands. They could not have got there by traveling near the surface of the earth, for the N. E. trade-winds would be dead against them. The conclusion thus becomes almost irresistible that they rose from the parched savannahs of the Amazon and Oronoco, where they were seen by Humboldt, into the upper regions of the atmosphere, and flowed over the N. E. trades in a N. E. direction, until some unknown cause has brought them to the surface of the earth about and within the Straits of Gibraltar.

We have also reason to believe, from these investigations, that the calms

of Cancer and of Capricorn are caused by the meeting of two upper currents—the one from the pole being dry, the other from the equator being charged with vapor; that there is a region of calms near the poles in which the barometer, on a level with the sea, stands lower than it does generally on the sea level of the earth, and the inquiry is suggested, whether the magnetic pole is not within this region; that the waters of the Mississippi River and great American lakes are rained from clouds, the vapor of which was taken up from the South Pacific Ocean; while the waters of the Amazon and Oronoco are evaporated exclusively from the Atlantic; that magnetism is probably an agent in giving direction to the circulation of the atmosphere, and the question is raised if it be not concerned in the currents of the ocean also; that the basin which holds the Gulf of Mexico is about a mile deep on the average; that the Caribbean Sea, in the deepest parts, is nearly three miles, if no more; that the North Atlantic is about five; the South, at least three; and the Gulf Stream, in the Florida Pass, 500 fathoms deep; that the same whale is found in Behring's Straits and Baffin's Bay; and the fact is pretty nearly proved that this fish cannot get from one place to the other, except through the Arctic Ocean, &c.

Among the remarkable things shown by these investigations are certain barometrical anomalies off Cape Horn. It is clearly established that the barometer stands, on an average, nearly an inch lower off Cape Horn than it does in the trade-wind region. A very small amount of this difference is due, according to the author, to the fact that the barometer at Cape Horn is several miles nearer to the center of the earth than it would be at the equator, and that thus there is greater attraction, and the mercury weighs more. The amount of superincumbent atmosphere is also less than at the equator; but these are small items in the account, for at St. Petersburg, in latitude 59 deg. 56 min. N., the mean hight of the barometer, reduced for a temperature of 62 deg., is 29.97.

The author, therefore, supposes that the difference is owing, in a great measure, to local agencies and causes, and calls upon navigators for more careful and extended observations upon this point.

It seems reasonable enough that observers should find a high barometer, (as is the case,) when on the western coast of Terra del Fuego and Patagonia; for there the prevailing strong westerly winds are stopped by the high, abrupt mountains of that country, causing an accumulation and piling up of the atmosphere. Something of the same kind is alluded to in the work before us, in discussing Lieut. Hendon's observations for the temperature of boiling water at the eastern foot of the Andes, in Peru, where it is supposed that the trade-winds are banked up by these mountains.

It is also equally reasonable that there should be a low barometer on the eastern coast of the same countries, for the mountains here make a lee and a partial vacuum, so that there is less pressure of the atmosphere; but neither of these causes can operate when the barometer is well to the southward of the Cape and entirely clear of the land. We must, therefore, leave this most interesting fact in physics unexplained until time, with thought, and the study of a more extended system of observations, shall unravel the mystery.

A long paper is devoted to Cape Horn passages and tracks, giving the experience of many of the co-operators in this work, and the author's views, opinions, and directions on the subject. He advises navigators to go to the westward of the Falkland Islands and through the Straits of Le Maire, if wind and daylight serve.

There is also an elaborate and interesting paper on the routes from Europe and the United States to Australia. In this connection, Mr. Maury's investigations have led him to differ from very high authority. He alludes to this difference in the following proper and modest manner:—

I do not venture lightly or without reflection to differ with the Hydrographic Office of England in matters of this sort. That is high authority I am aware. I allude to its work and the opinions uttered by it with the utmost respect. The object that I and those who co-operate with me have in view is the object for which the great Hydrographic Office of the world—that of the British Admiralty—was established and is maintained, viz., for the improvement of navigation, the benefit of Commerce, and the good of the sea-faring community.

Sailing directions, issued by the British Admiralty, recommend the Cape of Good Hope route and the parallel of 39 degrees south, as the best upon which to run down easting for Australia. Mr. Maury recommends that the Australia bound vessel should use a much higher parallel of south latitude on which to make his easting, on account of the strong westerly winds that are invariably found in high southern latitudes. He thinks a vessel should go at some seasons as far south as the parallel of 55 degrees. He states, in this connection, some facts that strike the man accustomed to look at routes only on a Mercator's Chart as very strange, that, for example, the great circle, (and of course the shortest distance,) between New York and Australia "passes very nearly through the axis of South America, thence south through the Antarctic regions, and so on northwardly again till it reaches the modern Ophir." Also, the fact, "that the Cape of Good Hope, instead of being a sort of half-way station on the road-side between Europe and the United States and New Holland, is some 1,000 miles or more to the northward of the shortest and best route." And again, that the course of vessels bound for the Cape of Good Hope, and of those bound for Australia, is the same until the region of the S. E. trade-winds in the Atlantic is passed, and that from that point the tracks diverge nearly at right angles—the Cape of Good Hope vessel steering a little to the southward of east, while the Australia trader should steer a little to the eastward of south.

We do not wish to create the impression that all this is not perfectly well known and clearly understood by the English Hydrographical Office, or that it is unaware of the strong westerly winds that prevail in high southern latitudes. It seems to direct the Cape of Good Hope and the parallel of 39 deg. on account of the ice and the tempestuous weather that may be encountered farther south. Mr. Maury thinks that there is no great danger to be anticipated from these causes. He exhibits the logs of several ships that have made fine runs in these high latitudes. Among them, the Sovereign of the Seas ran, in 22 days, 5,391 nautical miles, equal to 6,245 statute miles, or one-fourth the distance round the earth. She made a daily average of 283.9 statute miles; during eleven of these days consecutively her daily average was 354 statute miles, and during four days, also consecutive, she averaged as high as 398¾ statute miles. P. 757.

But it is on the passage from Australia homeward that the greatest difference is found between Maury's Sailing Directions and those of the English Hydrographic Office. Maury recommends that vessels should take advantage of the same westerly winds that have borne them so bravely along the parallels of 50 or 60 deg. to Australia, and, still steering east, (after getting in one of those parallels,) to double Cape Horn on the homeward track; while the Admiralty Sailing Directions prefer that vessels from Syd-

ney should steer to the northward, (at least in the winter time,) get in the S. E. trade-winds, and return by the Cape of Good Hope. The distance by either route is about the same. We think the English route the pleasantest, and probably the safest; Maury's far the quickest. He says:—

The opinion may be rash, or the expression of it may seem like a boast, but be it what it may, I here venture the prediction that the round voyage from the United States to Port Philip or Hobart Town and home again, can be made, and will be made under canvas, by the route here laid down, in 130 or 135 days or less. P. 752.

It used to be a ten months' voyage.

By an act of Congress, approved March 3, 1849, the Secretary of the Navy was authorized to assist me in the undertaking to investigate the phenomena of the winds and the waves, to find short routes, and to discover matters of importance to Commerce and navigation. The following is the joint resolution which expressed the wishes of Congress in the matter:—

"Sec. 2. And be it further enacted, That the Secretary of the Navy be directed to detail three suitable vessels of the navy in testing new routes and perfecting the discoveries made by Lieut. Maury in the course of his investigations of the winds and currents of the ocean; and to cause the vessels of the navy to co-operate in procuring materials for such investigations, in so far as said co-operation may not be incompatible with the public interest: provided, that the same can be accomplished without any additional expense." P. 213.

From this section of a law has sprung a new science, which Maury has Humboldt's authority for designating the "Physical Geography of the Sea." The men-of-war generally and the merchant-ships were giving him all the needful information to be had above the surface of the sea. He, therefore, undertook to employ the two small vessels that were placed at his disposal —the Taney and the Dolphin—in penetrating below the surface; in searching the chambers of the deep, and in "plucking up drowned science by the locks."

The subjects of observation to which the attention of these vessels was directed, were—

1. The force and direction of the wind, the hourly state of the weather, and all the meteorological conditions connected therewith—as thermal, dynamical, barometrical, and the like.
2. The force and set of currents, their depth and width, their temperature, and the position of their edges and limits.
3. Hourly observations upon the temperature of the surface water.
4. Frequent observations upon the temperature of the ocean at various depths.
5. Deep sea soundings.
6. Vigias and all dangers about which there are doubts, either as to existence or position.
7. Transparency and saltness, or the specific gravity of sea water in the different parts of the ocean.

With these instructions, Lieut. J. C. Walsh, in the Taney, and Lieuts. S. P. Lee and O. H. Berryman, in the Dolphin, with an occasional contribution from the regular men-of-war, have performed yeomen's service in this new and interesting field. By the most thorough system of search, they have erased from the charts no less than 30 supposed dangers, which have heretofore given to the anxious mariner many a watchful hour; they have discovered currents beneath the surface of the sea, and marked their depth, their force, their direction, and their temperature; and, lastly, by the

aid of several simple but ingenious contrivances, used with energy, perseverance, and the skill imparted by experience, they have sent the plummet where it never before reached, and brought from the "dark," and, hitherto, "unfathomed caves of ocean," things more precious than "gems of purest ray serene."

The implements used by these officers for their deep sea soundings were, a reel, made to fit firmly and securely in a boat; a 32, or two 32 pound shot for a plummet; and thousands of fathoms of strong, well-made fishing-line, of about one-tenth of an inch diameter, wound on the reel, and marked at every 100 fathoms. The soundings were always made from a boat. By means of the oars, the boat could be kept over the shot as it sank, and by noting the time of the running out of each hundred fathoms, a tolerably correct judgment might be had as to when the shot reached the bottom. Indeed, Berryman says that his officers became so expert, that they could tell by feeling the line whether the shot were pulling it out or whether it were merely carried out by the force of the drift.

With such simple implements as these, they have enabled Mr. Maury to draw a chart of the bottom of the North Atlantic, (Plate 14,) showing something of its configuration, and to pronounce authoritatively, that that sea is probably nowhere more than a little over five miles deep. More than eight miles of line have been run out; but on investigation of the circumstances attending, the sound showed, almost conclusively, that the plummet had been at the bottom long before the length had been run out, and that the line was still carried out by an under current.

The apparatus for observing these under currents is also very simple. Let us say, that it is desired to try the current at 100 fathoms below the surface. The boat is first anchored, as it were, either by her sounding line, with the shot on the bottom, or by lowering a large iron kettle to a considerable depth, when it is supposed that the surface current, acting upon the boat, will not be strong enough to drag that kettle, mouth first, through the water. The set and velocity of the surface current is then observed. Then a square wooden box, loaded just sufficiently to make it sink, is attached to the end of a line of 100 fathoms in length and thrown overboard. It, of course, sinks to the depth of that 100 fathoms; and a small keg, or inflated india-rubber bag, fastened to the other end of the 100-fathoms line, floats upon the surface, and prevents the box from sinking further. The box is now under the influence of any current that it may find at that depth, and carries the india-rubber bag on the surface in the same direction, and with the same velocity that it has itself. This direction and velocity is easily ascertained by means of the compass and log-line. Mr. Walsh, in giving an account of one of his experiments, says:—

> It was wonderful indeed to see this barrica (little barrel) move off against wind and sea and surface current, at a rate of over one knot the hour, as was generally the case, and on one occasion as much as 1¾ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had laid hold of the weight below and was walking off with it. Fifth edition, p. 168.

But the crowning triumph and most wonderful result of these investigations is in getting specimens of the bottom of the sea, from a depth of more than two miles. Until the last cruise of the Dolphin, under Berryman, the sounding line with its plummet was always lost—for, of course, the shot could not be hauled up from such a depth by so small a line; but at this

stage of the matter, Passed Midshipman J. M. Brooke, U. S. Navy, invented a contrivance by which the shot was detached from the line upon striking the bottom, and specimens of the bottom were brought up in its place.

These specimens were sent to Bailey, of West Point, and Ehrenburg, of Berlin, for microscopic examination. This examination has established the very remarkable fact that the specimens are all of the animal, not one of the mineral kingdom. Prof. Bailey, in a letter to Mr. Maury, of date of Nov. 29, 1853, says:—

> I was greatly delighted to find that *all* these deep soundings are filled with microscopic shells—not a particle of sand or gravel exists in them. They are chiefly made up of perfect little calcareous shells, (*foramenifera,*) and contain also a small number of silicious shells, (*diatomacea.*) P. 298.

We are concerned that we have neither time nor space to quote the entire paper (which Maury calls the "Ooze and Bottom of the Deep") upon this interesting subject. It is replete with full and varied knowledge, and rich with the suggestions of a profound and philosophic thought, set forth in the most attractive manner and glowing language.

The author thinks that a great work in the economy of nature is performed by these minute animalcules. He supposes, with Prof. Bailey, that they do not live where they are found, but in the water near the surface of the sea, and are buried in the "lichen caves below after death;" that they are, therefore, by filling up and leveling the bottom of the sea, performing there the geological work which "heat and cold, rain and sunshine, the winds and the streams, all assisted by the forces of gravitation," are performing upon the surface of the dry land above.

In his paper on the "Saltness of the Sea," p. 177, Mr. Maury all but demonstrates that these animalcules exercise a powerful influence in giving motion to the waters of the sea, and thus contributing to keep up the system of oceanic circulation.

In the paper at present under consideration he says:—

> Should it be established that these microscopic creatures live at the surface, and are only buried at the bottom of the sea, we may then view them as conservators of the ocean, for, in the offices which they perform, they assist to preserve its *status*, by maintaining the purity of its waters.
>
> It is admitted that the salts of the sea come from the land, and that they consist of the soluble matter which the rains wash out from the fields, and which the rivers bring down to the sea.
>
> The waters of the Mississippi and the Amazon, together with all the streams and rivers of the world, both great and small, hold in solution large quantities of lime, soda, iron, and other matter. They discharge annually into the sea an amount of this soluble matter which, if precipitated and collected into one mass, would no doubt surprise and astonish the boldest speculator with its magnitude.
>
> This soluble matter cannot be evaporated. Once in the ocean, there it must remain; and as the rivers are continually pouring in fresh supplies of it, the sea, it has been argued, must continue to become more and more salt.
>
> Now, the rivers convey to the sea this solid matter mixed with fresh water, which, being lighter than that of the ocean, remains for a considerable time at or near the surface. Here the microscopic organisms of the deep-sea lead are continually at work secreting this same lime, soda, &c., and extracting from the sea-water all this solid matter as fast as the rivers bring it down and empty it into the sea.
>
> Thus we haul up from the deep sea specimens of dead animals, and recognize in them the remains of creatures which, though invisible to the naked eye, have

nevertheless assigned them a most important office in the physical economy of the universe, viz., that of regulating the saltness of the sea.

This view suggests many contemplations. Among them, one in which the ocean is presented as a vast chemical bath, in which the solid parts of the earth are washed, filtered, and precipitated again as solid matter, but in a new form and with fresh properties.

Doubtless it is only a readaptation, though it may be in an improved form, of old and perhaps effete matter to the uses and well-being of man. P. 301.

A more interesting, ingenious, and possibly practical speculation, however, concerning these organisms, lies in this: the author asks the question—Did they live in the surface waters immediately above their place of burial, or were they brought from some remote region and there deposited? Should the microscope discover that these dead animals, found in one place, had living types only in another and far-distant one, the conclusion seems inevitable that they were borne thence by the currents of the ocean, sinking slowly in their progress until they reached their final resting place; and here, as in the case of the red fogs and sea-dust tallying the viewless winds, we have also tallies upon the invisible currents below the surface of the sea, by which to track them in their course. Mr. Maury says:—

It is vain to attempt to answer the *cui bono* in all the bearings of facts like these. Suffice it to say, they are physical facts—and in them, therefore, there is knowledge. They are facts that concern our planet, and touch the rightly-knowing and well-being of its inhabitants.

We perceive, however, that he has undertaken to draw a great and important conclusion from some of these facts, and to advocate a great practical enterprise. In a recent letter to the Secretary of the Navy, Mr. Maury shows, from his soundings, that there is a nearly level plateau from Newfoundland to the coast of Ireland, nowhere more than 1,500 fathoms deep; and from the perfect, unbroken, and unabraded condition of the shells of the deep-sea animalcules, he argues that there are no currents at the bottom of the ocean in that region, and therefore thinks that there are no difficulties which may not be overcome by skill and inventive genius. He proposes that the government should offer a premium as an incentive to the planning and undertaking of the work.

Our readers have now seen, imperfectly expressed, however, the great addition to human knowledge, and therefore to human prosperity and well-being, made by this most valuable book. A glance at the saving of money to our countrymen effected by it will close our notice:—

At the last meeting of the British Association, it was stated by a distinguished gentleman from Bombay, that where he came from it was estimated that a set of charts and sailing directions for the eastern seas, based upon the principles of these, would produce an annual saving to British Commerce that would be equivalent to a gain of from one million to two millions of dollars. P. 750.

Now let us make a calculation of the annual saving to the Commerce of the United States effected by those charts and sailing directions. According to Mr. Maury, the average freight from the United States to Rio Janeiro is 17.7 cts. per ton per day, to Australia 20 cents, to California also about 20. The mean of this is a little over 19 cents per ton per day, but to be within the mark we will take it at 15, and include all the ports of South America, China, and the East Indies.

The Sailing Directions have shortened the passages to California 30 days, to Australia 20, to Rio Janeiro 10. The mean of this is 20, but we will

take it at 15, and also include the above-mentioned ports of South America, China, and the East Indies.

We estimate the tonnage of the United States engaged in trade with these places at 1,000,000 of tons per annum.

With these data, we see that there has been effected a saving for each one of these tons of 15 cents per day, for the period of 15 days, which will give an aggregate of $2,250,000 saved per annum. This is on the outward voyage alone, and the tonnage trading with all other parts of the world is also left out of the calculation. Take these into consideration, and also the fact that there is a vast amount of foreign tonnage trading between these places and the United States, and it will be seen that the annual sum saved will swell to an enormous amount.

And this is the result of an idea worked out with deep thought, patient labor, and untiring perseverance. It will confer imperishable renown, but we think it wrong and hard that it should confer no profit. Could Mr. Maury, like the ordinary inventor, sell his idea; could he take out a patent, and, by authority, put toll-gates upon the ocean, charging the vessels that used his new and improved road but the fraction of a penny upon their tonnage, (which their owners would freely pay,) his income from this source would be in some manner commensurate with the benefits conferred and the saving effected. But since this cannot be so, we think that it would be true policy in this great and rich government to buy his idea and its results, the Wind and Current Charts and Sailing Directions, and thus reward, in the only proper way it can, its distinguished servant.

Art. II.—COMMERCE OF THE UNITED STATES.

NO. VII.

NAVIGATION ACT OF 1651—MINT IN MASSACHUSETTS—CLAYBORNE AGAIN—NAVIGATION ACT OF 1660, ITS EFFECT UPON ENGLAND AND THE COLONIES—MINT IN MARYLAND—RHODE ISLAND CHARTER—AMENDMENT OF THE NAVIGATION ACT—NEW YORK—FRENCH WEST INDIA COMPANY—SHIPBUILDING IN MASSACHUSETTS—LOGWOOD CUTTING AT HONDURAS—THE MISSISSIPPI.

In 1651, premiums were offered in Virginia to encourage the growth of Wheat, and the production of Wine. A little wine had been made in 1647; it was more than a century later before wheat came much into cultivation.

The Rump Parliament, with that regard to the commercial interests of England which was exhibited throughout the whole Republican period, but particularly incited by hostility to Holland, and a desire to destroy alike her commercial eminence and the naval power built up thereon, turned its attention to the protection and encouragement of English navigation, and enlargement of the English navy.* The Dutch were now the great carriers of the world. Having but few exportable products of their own, they relied for employment on their merchant ships, and for the means of sustaining

* War broke out between the Republics of England and Holland in 1652, ending in three years, with the humbling of the latter. Blake and Dean were the English admirals, opposed by De Ruyter and Van Tromp. John De Witt was at the head of the Dutch ministry, Sir Henry Vane directed the English naval and foreign department, until Cromwell came into power. These two were among the ablest ministers of the time.